

THE EFFECT OF PLANTING SPACE AND LEVEL OF PHOSPHOR FERTILIZER DOSE ON GROWTH, DRY MATTER YIELD, AND CRUDE PROTEIN CONTENT OF *Indigofera arrecta*

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ABSTRACT

Study on *Indigofera arrecta* has not been explored widely yet. Therefore, its growth characteristic and its nutritive value need to be studied. The research was conducted to evaluate growth characteristic and its nutritive value of *Indigofera arrecta* planted on different planting spaces and different levels of NPK fertilizer dose. Two factors experiments were assigned in a Split-Plot Design. The first factor (A) was planting space, (1) 50x50 cm and (2) 75x75 cm. The Second factor (B) was level of fertilizer dose, (1) 0 kg P₂O₅/ha+100kg K₂O/ha, (2) 100kg P₂O₅/ha +100kg K₂O kg/ha and (3) 200kg P₂O₅+100kg K₂O/ha. The results showed that planting space had no effect on height of plant ($P>0.05$) but diameter of stem were statistically different ($P<0.05$). In addition, their dry matter yield and crude protein content were not different ($P>0.05$) on either planting space or P fertilizer dose. There were no interaction between planting space and P fertilizer dose. In addition, there were no effects either planting space or P fertilizer dose on dry matter edible part, crude protein content, and plant height. *Indigofera arrecta* planted on wider planting space produce bigger stem diameter and bigger number of branch.

Keywords: *Indigofera*, nutritive value, phosphor, planting, space yield

INTRODUCTION

Indigofera arrecta is one of kind browse leguminous plant, growing erect, woody stem as animal feed, and slopping plant to prevent erosion. This plant has 5-8 pairs leaflet, green color and its height reached 2 m. (Andrews, 1952 cited by Skerman, 1977). The leaf of *Indigofera arrecta* is similar to the leguminous plant, containing high crude protein, β -carotene and xanthophylls. The *Indigofera* leaf supplementation on duck and quail resulted high *Yolk Color Score* (Akbarillah *et al.*, 2002, 2005).

The leguminous plant needs a large amount of phosphor for nodulation and nitrogen fixation Skerman (1977) reported that the amount of legume nodule increased a long with increased phosphor availability. The number of nodule density (the nitrogen fixation part by rhizobium) and Nitrogen fixation velocity are stimulated by phosphor.

Planting space affects plant growth stage. Short distance (increased density) increases nutrient requirement and sunlight competition. In addition, increasing density affected environment

temperature and humidity. The change of environment temperature will affect growth and plant metabolism (Van Soest, 1994). Increasing environmental temperature affects biochemistry process. Increasing cell temperature cause velocity of activation (vibration, rotation and translation) so that molecule reaction is faster. Increasing temperature and stimulation of temperature will damage structure and velocity of reaction (Fitter and Hay, 1994). Plant converts photosynthesis product to be structural component faster along with increasing temperature. The forage growing on the land with higher temperature has higher legum of plant cell wall and faster metabolic activity, therefore pool metabolic in the cell is decreased (Van Soest, 1994). Plant needs certain air humidity for the life. Air humidity affects physiology process of plant. High air humidity inhibits transpiration process. Transpiration is important in mineral transportation from root to other parts of plant such as leaf. Plants response variable temperature and water for shoot weight, root weight, shoot/root ratios and number of roots (Kendall *et al.*, 2006). Light is needed for photosynthesis

process. Amount of light required by a plant depends on the light quality, wavelength and light intensity (amount of light per cm² per second and its duration (Dwidjoseputro, 1978). The light affects growth, production and chemical composition of forage. Light is restricted factor on forage growth in shading land (Akbarillah *et al.*, 2002). Study by Akbarillah *et al.* (2002) showed that the spacing 1.5mX1.5m resulted the highest forage production ($P>0.05$) per area unit while the spacing 3.5mX3.5m had the forage production per plant. Percentage of utilization of native herbage dropped as forage of the woody species increased (Ainalis and Tsiouvaras, 2004).

Indigofera arrecta in early stage planted in the different shading area showed difference growth characteristic (Akbarillah *et al.*, 2002). The research was conducted to evaluate dry matter production, crude protein content of *Indigofera arrecta* planted on certain planting space and dose of Phosphor fertilizer. The research was expected to contribute on optimal land usage especially on availability of ruminants feed to support agro forestry and integrated sustainable farming system.

MATERIALS AND METHODS

Experimental Design

The experimental design on the research used a split plot design (Gomez and Gomez, 1984). The main plot was planting space 50 cm X 50 cm and 75 cm X 75 cm and the sub plot was dose of phosphor fertilizer. Fertilizer used was super phosphate contain 36% P₂O₅ and KCl contain 60% K₂O. The treatment dose of fertilizer were (1) 0 kg P₂O₅/ha+100 kg K₂O/ha., (2) 100 kg P₂O₅/ha +100 kg K₂O kg/ha and (3) 200 kg P₂O₅+100 kg K₂O/ha.

The plants used were 1 year old *Indigofera arrecta*. They were planted by planting space 50 cm X 50 cm and 75 cm X 75 cm. The plants were initially fertilized with organic fertilizer in equal dose. Every planting space was treated 3 doses of fertilizer. Every dose had 4 replications. Initial cutting was done at 60cm plant height. Area signed with number and code by colored plastic. Fertilizing as in hole of soil and covered it with soil (side dressing). The observation started after initial cutting and ended after 12 weeks.

Parameter measured

Parameter measured were plant height (cm), number of branch, stem diameter (cm) dry matter

production and crude protein content (%) of *Indigofera arrecta* harvested by cutting stem on 60 cm plant height and branch was cut at 5cm long after 12 weeks observation.

Harvested part classified to edible part (the parts of plant that animal would eat these were leaf and stem diameter less than 6 mm) and inedible part. Parts that were not eat by animal, these were stem having diameter more than 6 mm). After *Indigofera arrecta* weighed, the sample of *Indigofera arrecta* was dried using force air circulation oven at 45°C for two days, and samples were then weighed. Dry samples were ground on screening diameter 1 mm for chemical analyses (dry matter and crude protein content, AOAC,1976).

Data Analysis

The data were analyzed using Analysis of Variance, if the result were significant different they were continued by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

The research showed that the characteristics of *Indigofera arrecta* planted at different planting space 50 cm X 50 cm and 75 cm X 75 cm were not significant different ($P>0.05$) on plant height (Table 1). Nevertheless, stem diameter and number of branch showed significant effect ($P<0.05$). Wider planting space caused growth media to be more spacious, therefore nutrient in the soil and light were more available. As a result, diameter and height of plant growth as well as plant branch increased. Plant growth was affected by environmental factors such as temperature, humidity, nutrients, and light (Chen, 1990; Ong and Mathuya, 1992; Saini and Misra, 1992). Planting space affected micro environment (temperature, humidity and light) and expanded the rod to uptake nutrient. In this case, both of planting space were not enough to influence of micro environment, especially on nutrient uptake and light competition. In contrast, stem diameter and number of branch were affected by planting space ($P<0.05$). Planting space affected micro climate environment to plant, therefore it increased more number of branch and wider stem diameter.

The increasing level of phosphor fertilization used did not affect *Indigofera arrecta* growth characteristic (height, stem diameter and number of branch). There were no interaction between

Table 1. The Average of Plant Height, Stem Diameter and Number of Branch *Indigofera arrecta*

| Treatment | Height (cm/plant) | Diameter | No of Branches |
|---|----------------------|----------|-------------------|
| Planting space (the effect of plot) | | | |
| A1 (50x50 cm) | 146.22 | 0.22a | 8.80a |
| A2 (75x75 cm) | 146.42 | 0.32b | 16.80b |
| Significance | ns | * | ** |
| Fertilizing (the effect of sub plot) | | | |
| B1 (0 kg P ₂ O ₅ /ha) | 145.73 | 0.24 | 11.7 |
| B2 (100 kg P ₂ O ₅ /ha) | 145.93 | 0.26 | 11.8 |
| B3 (200 kg P ₂ O ₅ /ha) | 147.3 | 0.31 | 14.9 |
| Significance | ns | ns | ns |
| Plant space x Fertilizing | | | |
| A1B1 | 146.7 | 0.19 | 8.4 |
| A1B2 | 145.4 | 0.19 | 7.9 |
| A1B3 | 145.55 | 0.29 | 10.1 |
| A2B1 | 144.75 | 0.29 | 15 |
| A2B2 | 146.45 | 0.33 | 15.7 |
| A2B3 | 148.05 | 0.31 | 19.7 |
| Significance | ns | ns | ns |

Different superscript at the same column is statistically different (P<0.05), ns=non significance (P>0.05),

*= significance (P<0.05), **=significance (P<0.01)

Table 2. The Average of Dry Matter Part and Crude Protein Content of *Indigofera arrecta* on Different Planting Space and Phosphor Fertilizing Dose

| Treatment | Height (cm/plant) | Diameter |
|---|----------------------|----------|
| Planting space (the effect of plot) | | |
| A1 (50x50 cm) | 665.94 | 23.12 |
| A2 (75x75 cm) | 615.64 | 23.74 |
| Significance | ns | ns |
| Fertilizing (the effect of sub plot) | | |
| B1 (0 kg P ₂ O ₅ /ha) | 587.51 | 22.96 |
| B2 (100 kg P ₂ O ₅ /ha) | 633.74 | 23.38 |
| B3 (200 kg P ₂ O ₅ /ha) | 701.11 | 24.45 |
| Significance | ns | ns |
| Plant space x Fertilizing | | |
| A1B1 | 607.68 | 22.91 |
| A1B2 | 692.43 | 23.40 |
| A1B3 | 697.70 | 24.02 |
| A2B1 | 567.34 | 23.01 |
| A2B2 | 575.06 | 23.35 |
| A2B3 | 575.06 | 24.87 |
| Significance | ns | ns |

ns=non significance (P>0.05)

planting space and dose of fertilizer (P>0.05). Phosphor fertilizing in condition where rain fall was 67.83 mm/month, temperature was 29°C and air humidity was 78.53%, cause restricted water availability. The rod absorption of phosphor was therefore inhibited. As a result, the growth was not optimal (Akbarillah *et al.*, 1999), physiology and morphology of plant activity was disturbed by limited water availability (Dwidjoseputro, 1978). There was no interaction between treatments on plant height, stem diameter and number of branch (P>0.05).

The dry matter production, included leaf and branch as animal consumed (edible part) can be seen on Table 2. Density of plants caused by difference planting space did not affect dry matter production of leaf and branch, as animal consumed (edible part) (P>0.05). Planting space should be distinguished competition stage for nutrient and light. Eventhough there were not statistically difference, there were tendency that longer planting space produced higher dry matter biomass per plant. Nevertheless, if the dry matter production converted in to production per square space, shorter plant space produced higher biomass as a result number of population per square space increased. Increasing number of plant population per square space would cause higher dry matter production. (Akbarillah *et al.*, 2005). The result of this research was higher than the result reported by Akbarillah *et al.* (2005). Akbarillah *et al.* (2005) reported that *Indigofera* fertilized by organic fertilizer produced dry matter of edible part in average as 209.62 g/m² and 290.26 g/m² on planting space 50 X 50 cm and 75 X 75 cm, respectively. Hassen *et al.* (2006) explained that dry matter production of *Indigofera arrecta* was 272.8 g/m² in the first year, the production of dry matter reached 1662 g/m² in second year. Dry weight shoot of *Indigofera arrecta* fertilized with 90 kg/ha P₂O₅ and fertilizer base of 110 kg/ha K₂O and 55kg/ha N was 451.09 g/m² at planting space 50X50cm and 178.32g/m² at planting space 75X75 cm (Siddiqui *et al.*, 2007).

Consistent with addition plant height and stem diameter, fertilizing dose had no significant effect (P>0.05) on dry matter *edible part*. This result might be caused by climate condition which was not appropriate, such as low rainfall (67 mm/month) and environment temperature 29°C, whereas Siddiqui *et al.* (2007) did intercultural operation and irrigation as necessary.

Crude protein content of *Indigofera arrecta*

was not affected by treatment planting space and phosphor dose. Planting space and phosphor dose more affected on biomass yield (Akbarillah *et al.*, 2005). Protein content of leguminous crop leaves are rarely affected by agronomic and management practices. On the other hand, agronomic and management practices may effectively affect on protein content of grass species.

CONCLUSION

It can be concluded that there was no interaction between planting space and P fertilizer dose. In addition, there were no effects either planting space or P fertilizer dose on dry matter edible part, crude protein content, and plant height. *Indigofera arrecta* planted on wider planting space produced bigger stem diameter and bigger number of branch.

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